**CLAIMS**

1. An injection molding apparatus, comprising:

a mold block, a nozzle, a gating system, and a slug heater;

the mold block defining a mold cavity having a mold cavity inlet,

the nozzle having a nozzle inlet, wherein the nozzle inlet is fluidically connectable downstream from a melt source and wherein the nozzle inlet is upstream from the mold cavity inlet, and wherein a melt flow passage extends from the nozzle inlet to the mold cavity inlet,

the gating system including a valve pin and an actuator, wherein the valve pin is movable between an open position wherein melt flow is permitted into the mold cavity, and a closed position wherein the valve pin blocks the melt flow passage to prevent melt flow into the mold cavity, wherein the actuator is operatively connected to the valve pin to move the valve pin between the open and closed positions,

and wherein at least one of the mold block and the valve pin includes a cooling system for selectively solidifying melt to form a slug immediately upstream from the valve pin when the valve pin is in the closed position, wherein, in use, the slug blocks the melt flow passage to substantially prevent melt leakage past the slug when the valve pin is positioned away from the slug,

and wherein the slug heater is thermally connectable to the slug and wherein the slug heater is configured for selectively melting the slug sufficiently to permit melt flow in the melt flow passage.

2. An injection molding apparatus as claimed in claim 1, wherein the valve pin is positioned in the mold block.

3. An injection molding apparatus as claimed in claim 1, wherein the mold block includes a first mold plate and a second mold plate, and the first and second mold plates are positionable in a mold-closed position wherein the first and second mold plates mate together to define the mold cavity, and an ejection position wherein the first and second mold plates are separated sufficiently for the ejection of a molded part from the mold cavity,

and wherein in the ejection position the valve pin is positioned away from the slug.

4. An injection molding apparatus as claimed in claim 1, wherein the melt flow passage includes a slug formation portion, wherein at least a portion of the slug formation portion has a cross-sectional area that reduces in a downstream direction, and the valve pin is movable to a position immediately downstream from the slug formation portion in the closed position, so that the slug is formed in the slug formation portion.

5. An injection molding apparatus as claimed in claim 4, wherein the slug formation portion is generally frustoconical.

6. An injection molding apparatus as claimed in claim 4, wherein the gate passage further includes a valve pin sealing portion that is immediately downstream from the slug formation portion, wherein the valve pin sealing portion is configured to cooperate with the valve pin to seal against melt flow therebetween.

7. An injection molding apparatus as claimed in claim 6, wherein the valve pin sealing portion is cylindrical.

8. An injection molding apparatus as claimed in claim 1, wherein the nozzle defines a nozzle melt channel, and wherein the nozzle melt channel extends generally linearly through the nozzle.

9. An injection molding apparatus as claimed in claim 1, wherein the nozzle includes a nozzle heater and wherein the slug heater comprises the nozzle heater.

10. An injection molding apparatus as claimed in claim 9, wherein the nozzle has a nozzle body and the nozzle heater is attached to the nozzle body.

11. An injection molding apparatus as claimed in claim 10, wherein the nozzle defines a nozzle melt channel, and wherein the nozzle melt channel and the nozzle heater are both concentric about a common axis.

12. An injection molding apparatus as claimed in claim 1, wherein the valve pin includes a valve pin heater, wherein the slug heater includes the valve pin heater.

13. An injection molding apparatus as claimed in claim 1, wherein the melt flow passage includes a slug formation portion wherein, in use, the slug forms, and wherein the melt flow passage includes a slug release portion, wherein the slug release portion is in the nozzle, and wherein the slug release portion is heated sufficiently to maintain melt therein in a liquid state and wherein the cross-sectional area of the slug release portion larger than that of the slug formation portion, and wherein the valve pin is further movable to a slug release position, and wherein movement of the valve pin from the closed position to the slug release position drives the slug from the slug formation portion of the melt passage to the slug release portion of the melt flow passage.

14. An injection molding apparatus as claimed in claim 1, wherein the valve pin includes a cooling system to selectively cool and solidify melt immediately upstream therefrom to facilitate formation of the slug.

15. An injection molding apparatus as claimed in claim 14, wherein the valve pin includes a valve pin body and wherein at least a portion of the valve pin body is hollow and is connectable to a source of coolant fluid for circulating coolant fluid through the valve pin body.

16. An injection molding apparatus as claimed in claim 15, wherein the valve pin includes a valve pin body and wherein at least a portion of the valve pin body is hollow and is connectable to a source of heating fluid for circulating heating fluid through the valve pin body to selectively heat the valve pin, thereby forming a valve pin heater, and wherein said slug heater includes the valve pin heater.

17. An injection molding apparatus as claimed in claim 1, wherein the mold block includes a plurality of mold cavities and the melt flow passage is in fluid communication with the plurality of mold cavities and wherein in the closed position, the valve pin blocks a portion of the melt flow passage upstream from all of the mold cavities.

18. A method for controlling melt flow in an injection molding apparatus, the injection molding apparatus including a mold block, a manifold, and at least one nozzle, the mold block defining a mold cavity having a gate passage thereto, the at least one nozzle defining a nozzle melt channel for transferring melt from a melt source to the gate passage, the method comprising:

providing at the gate passage, a valve pin that is movable between an open position wherein the valve pin is at least partially removed from the gate passage to permit melt flow through the gate passage, to a closed position wherein the valve pin cooperates with the gate passage to inhibit melt flow therebetween, wherein the valve pin is positioned outside the nozzle melt channel in both the open and closed positions and is positioned away from the mold cavity in both the open and closed positions; and

moving the valve pin between the open position and the closed position to control the flow of melt into the mold cavity.

19. A method as claimed in claim 18, further comprising solidifying melt immediately upstream of the valve pin to form a slug when the valve pin is in the closed position, and forming a seal between the slug and the gate passage to inhibit melt leakage therebetween.

20. A method as claimed in claim 19, further comprising removing the valve pin from the gate passage after forming the seal between the slug and the gate passage.

21. A method as claimed in claim 19, wherein the mold block includes a first mold plate and a second mold plate, and the first and second mold plates together define the mold cavity, and the method further comprises:

positioning the first and second mold plates in an ejection position after forming the seal between the slug and the gate passage, wherein in the ejection position the first and second mold plates are separated sufficiently for the ejection of the molded part from the mold cavity, and wherein in the ejection position the valve pin is removed from the gate passage; and

ejecting the molded part from the mold cavity when the first and second mold plates are in the ejection position.

22. A method as claimed in claim 21, further comprising:

positioning the first and second mold plates in a mold-closed position after ejecting the molded part from the mold cavity, wherein in the mold-closed position the first and second mold plates mate together to define the mold cavity; and

heating the slug to liquefy the slug sufficiently to permit melt to flow into the gate passage and into the mold cavity.

23. A method as claimed in claim 22, further comprising moving the valve pin to drive the slug out of the gate passage after moving the first and second mold plates to the mold-closed position and prior to completion of the heating step.

24. A method as claimed in claim 18, wherein the mold block includes a plurality of mold cavities and a plurality of gate passages thereto, and wherein the plurality of gate passages are in fluid communication with the nozzle melt channel via a common inlet portion, and wherein in the closed position the valve pin cooperates with the common inlet portion to prevent melt flow into the plurality of mold cavities.

25. An injection molding apparatus, comprising:

a mold block, at least one nozzle and at least one gating system,

the mold block defining a mold cavity having a gate passage thereto,

the at least one nozzle defining a nozzle melt channel, wherein the nozzle is positionable so that the nozzle melt channel is downstream from a melt source and is upstream from the gate passage,

the at least one gating system including a valve pin and an actuator,

wherein the valve pin is movable between an open position wherein the valve pin is at least partially removed from the gate passage to permit melt flow into the mold cavity, and a closed position wherein the valve pin cooperates with the gate passage to prevent melt flow into the mold cavity;

wherein the actuator is operatively connected to the valve pin to move the valve pin between the open and closed positions,

wherein the valve pin is positioned outside of the nozzle melt channel in both the open and closed positions,

wherein the valve pin is positioned in the mold block, and

wherein the valve pin is generally opposed to and is movable co-axially with the nozzle melt channel.

26. An injection molding apparatus as claimed in claim 25, wherein the mold block includes a plurality of mold cavities and a plurality of gate passages thereto, and wherein the plurality of gate passages are in fluid communication with the nozzle melt channel via a common inlet portion, and wherein in the closed position the valve pin cooperates with the common inlet portion to prevent melt flow into the plurality of mold cavities.

27. An injection molding apparatus as claimed in claim 25, wherein the melt flow is a metal.

28. An injection molding apparatus as claimed in claim 25, wherein said mold component is adapted to selectively solidify melt immediately upstream of said valve pin to form a slug when said valve pin is in said closed position, wherein, in use, said slug forms a seal with said gate passage to inhibit melt leakage therebetween when said valve pin is positioned away from said slug.

29. An injection molding apparatus, comprising:

a mold block, a nozzle and a gating system,

the mold block defining a plurality of mold cavities and a plurality of gate passages thereto, wherein the plurality of gate passages are in fluid communication with a common inlet portion,

the nozzle defining a nozzle melt channel, wherein the nozzle is positionable so that the nozzle melt channel is downstream from a melt source and is upstream from the common inlet portion,

the gating system including a valve pin and an actuator,

wherein the valve pin is movable between an open position wherein the valve pin is at least partially removed from the common inlet portion to permit melt flow into the plurality of mold cavities, and a closed position wherein the valve pin cooperates with the common inlet portion to prevent melt flow into the plurality of mold cavities,

wherein the valve pin is positioned outside of the nozzle melt channel in both the open and closed positions,

and wherein the actuator is operatively connected to the valve pin to move the valve pin between the open and closed positions.